Construction Contracts Administration, Procurement Contracts & Materials Management (PCMM)
Oregon State University
644 SW 13th Ave.
Corvallis, Oregon 97333

P 541-737-3401
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5/24/2019

Oregon State University
Construction Contract Administration
ITB 199053 – MERRYFIELD HALL RENOVATION RE-BID

ADDENDUM NO. 6

THIS ADDENDUM IS BEING ISSUED for clarification and/or revisions of the Solicitation Documents as noted. This document is hereby made a part of the Solicitation Documents to the extent as though it was originally included therein.

ITEM NO. 1 Included with this addendum are substitution request responses as provided by Benchmark Architectural Services (dated 5/23/2019).

END OF ADDENDUM NO. 6

BENCHMARK ARCHITECTURAL SERVICES

2897 FIRWOOD PL. S.E., ALBANY, OREGON 97322 PHONE/FAX (541) 704-0619, benchmark@proaxis.com

May 23, 2019

Mr. Matt Hausman
Mr. Dave Raleigh
Oregon State University
Construction Contracts Administration
130 Oak Creek Building
Corvallis, Oregon 97331

Subject: OSU Merryfield Hall Renovation Project ReBid
Addenum #6

Dear Matt and Raleigh,

In response to omission of approved substitution requests from the listing included in Addendum #5 it has been determined that the following corrected Substitution Request Responses shall be incorporated into the bidding documents:

C. Substitution Request Responses: Substitution requests for products by the following manufacturers or suppliers have been reviewed and given approval or conditional approval. Bidders shall verify specific products addressed by the approval and any conditions placed upon the approval of the substitution request prior to incorporating the product(s) into their Bid.

1) LG Energy Recovery Ventilator
2) YORK Air Handling Units

Please include this information in the next Addendum released and contact me if you have any questions or if you require any additional assistance at this time.

Sincerely,

Gary Day

Attachments:

a. LG ERV
b. YORK AHU

SUBSTITUTION REQUEST FORM

TO: Benchmark Architectural Services

PROJECT: OSU Merryfield Hall Renovation Project

SPECIFIED ITEM:

238129	213	2.6	Dedicated Outside Air Unit
Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: LG ARVU123ZFA2

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.

2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.

3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.

4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted by: Austin Brown

Signature Austin Brown

Firm Johnson Barrow Oregon

Address 735 SW 20th Pl. Portland, OR 97205

Date May 10th, 2019

Telephone 971-717-7123

Attachments:

For use by Design Consultant:

☒ Accepted ☐ Accepted as noted

☐ Not Accepted ☐ Received too late

By David Blacic

Date 5/15/2019

Remarks

Job Name/Location: OSU Merryfield Hall **Tag #:** DOAS-1

Date: 05/10/2018

For: ☐ File ☐ Resubmit ☑ Approval ☐ Other

PO No.:

Architect: Benchmark Architectural Services GC:

Engr: Insite Group Mech:

Rep: Johnson Barrow Oregon

(Company) (Project Manager)

ARVU123ZFA2
Energy Recovery Ventilator (ERV)

LG Life's Good

Performance:

Nominal Capacity (CFM)	1,180
Power Input SH (W)	980

Capacities are in accordance with AHRI Standard 1060.

Heat Exchanger Data:

Air-to-Air Heat Exchanger	Cross flow fixed core
Quantity	2
Temperature Exchange Efficiency (%)	
Cooling (fan speed SH)	59
Heating (fan speed SH)	58
Enthalpy Exchange Efficiency (%)	
Cooling (fan speed SH)	34
Heating (fan speed SH)	49

Electrical:

Power Supply (V/Hz/Ø)	208-230/60/1
Rated Amps SH (A)	6.82

Controls Features:

Stand Alone Mode:

•Can be operated independently

Ventilation Heat Exchange Mode:

•Draws outdoor air and indoor exhaust air across air-to-air heat exchanger

Ventilation Normal (Bypass) Mode:

•Controls by-pass damper to bypass air-to-air heat exchanger and draw in untempered outdoor air

Optional Accessories:

☐ LG Programmable Thermostat - PREMTB10U

☐ PI485 (required for central controller) - PSNFP14A0

Operating Range:

Outdoor Temperature (°F DB)	14-113

Unit Data:

Sound Pressure SH/H/L dB(A)	45/41/35
Filter	Washable
Quantity	4
Net Unit Weight (lbs)	331
Shipping Weight (lbs)	397

Fan:

Type	Cross Flow
Quantity	4
Motor/Drive	Brushless Digitally Controlled/Direct
Airflow Rate SH/H/L (CFM)	1,177/1,177/942
External Static Pressure SH/H/L (in wg)	0.64/0.36/0.20

Notes:

1.SH = super high speed, H = high speed, L= low speed
2.All communication cable to be minimum 18 AWG, 2-conductor, stranded, shielded and must comply with applicable local and national code.
3.Power wiring cable size must comply with the applicable local and national code.
4.Must follow installation instructions in the applicable LG installation manual.
.

Intertek

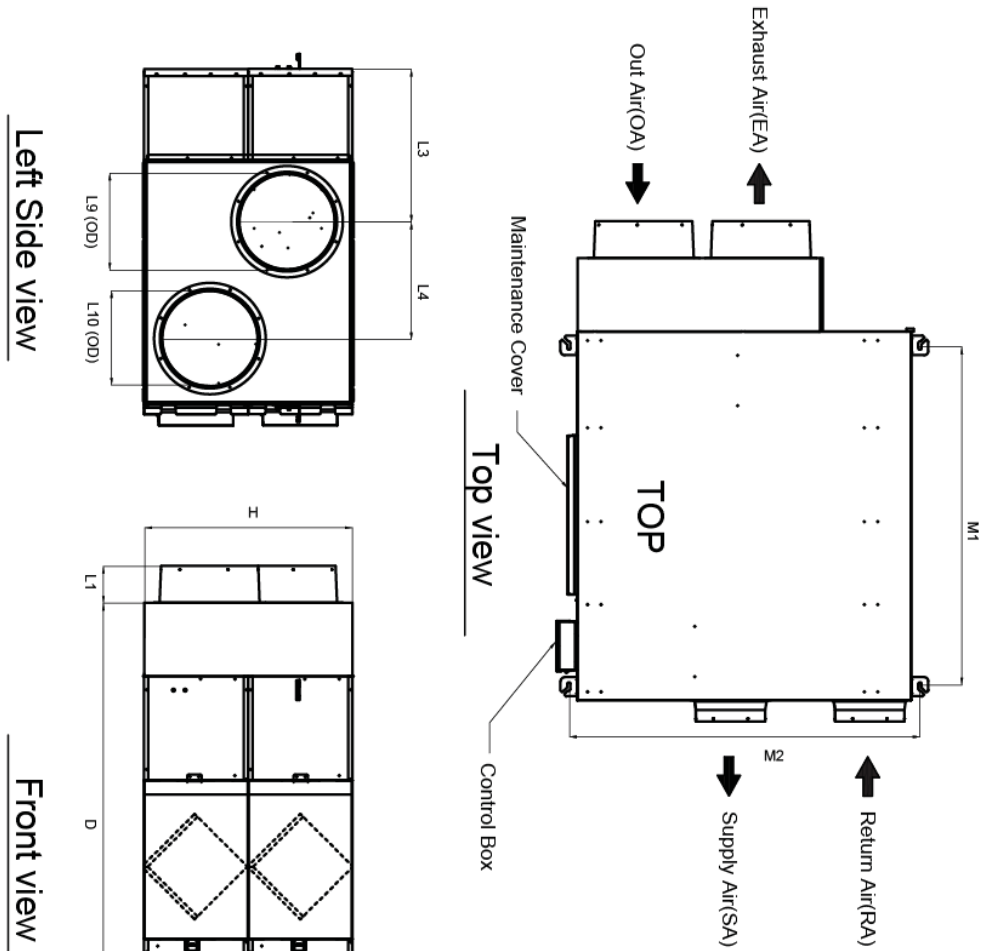
AHRI CERTIFIED® www.ahridirectory.org Air-to-Air ERV AHRI Standard 1060 Energy Recovery COMPONENT is certified. Actual performance in packaged equipment may vary.

ARVU123ZFA2
Energy Recovery Ventilator (ERV)

Tag #: DOAS-1

Date: 05/10/2018

PO No.:



W	44 7/8"
D	41 13/16"
H	29 1/16"
L1	5 1/8"
L2	3 1/8"
L3	19"
L4	16 1/8"
L5	5 3/4"
L6	20 3/16"
L7	9 9/16"
L8	9 9/16"
L9	13 3/4"
L10	13 3/4"
L11	3 7/8"
M1	38 7/8"
M2	46 5/16"

SUBSTITUTION REQUEST FORM

TO: Benchmark Architectural Services

PROJECT: OSU Merryfield Hall Renovation Project

SPECIFIED ITEM:

237313	194	2.3	Indoor, Basic Air-Handling Units
Section	Page	Paragraph	Description

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: York Solution Semi-Custom AHU

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.

2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.

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Submitted by: Austin Brown

Signature Austin Brown

Firm Johnson Barrow Oregon

Address 735 SW 20th Pl. Portland, OR 97205

Date May 10th, 2019

Telephone 971-717-7123

Attachments:

For use by Design Consultant:

☒ Accepted ☐ Accepted as noted

☐ Not Accepted ☐ Received too late

By David Blacic

Date 5/15/2019

Remarks Please provide submittals per specifications.

YORK®

SOLUTION
ENGINEERING GUIDE

10020L

10020M

MANUFACTURER CERTIFIED TO ARI AS COMPLYING WITH ARI STANDARD 430 • CENTRAL STATION AIR-HANDLING UNITS

ISO 9002 Registered

ETL® LISTED

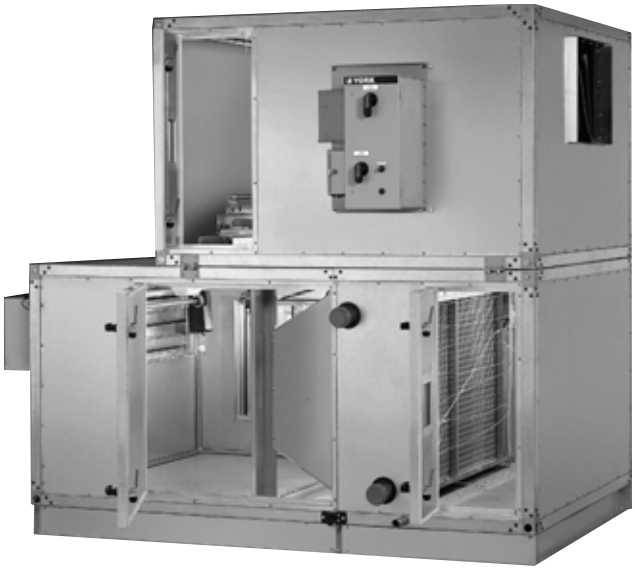
General Information

EXPERIENCE

Solution™ Custom air-handling units (AHUs) from YORK®—the only names you need to know for a line that has no limits. YORK engineers have developed an AHU line that is so flexible, and able to deliver such high standards of performance, that it can handle virtually any application. Whatever the air-handling challenge—IAQ, acoustics, energy, controls, you name it—YORK can build a Solution Custom AHU that will meet your needs.

FLEXIBILITY

Solution Custom AHUs offer the ultimate in dimensional, material, and component flexibility. This gives you the versatility to meet any air-system requirement.



***Dimensional Flexibility*:** You can design Solution Custom AHUs to fit the application and the space. Length, height and width can all be varied to match building constraints. With variable aspect cross-sectional possibilities, you choose the best match for the application. In addition, all Solution Custom AHU components have been designed with a variable-aspect ratio to meet your space and air-velocity requirements.

***Material Flexibility*:** A complete line of construction materials are available, including G-90 galvanized steel, aluminum, painted steel, stainless steel, and more. Solution Custom AHUs can handle a multitude of environments, from the most benign to the most corrosive.

***Component flexibility*:** Today's AHUs are responsible for providing the built environment with quality indoor air, in an energy-efficient and quiet manner. Solution Custom AHUs help you meet that responsibility by offering every available component, from energy wheels to UV lights, from air-monitoring stations to specialty-purpose filters. And as technology creates new capabilities, YORK will apply these to our Solution Custom line.

PERFORMANCE

How an air-handling unit is designed and built determines how well it performs, and Solution Custom AHUs are built for performance. They have been tested in accordance with ARI Standard 430, evaluating the performance of the entire unit. They have also undergone extensive and rigorous testing to verify conformance with all U.S. and Canadian safety standards, and they bear the ETL Label.

IAQ

AHU leakage is an enemy of indoor air quality. It can deteriorate the quality of the supply air by allowing dirty, unfiltered air to seep into the airstream downstream of the filters. To prevent this leakage, the rigid, thermally superior panels of Solution Custom AHUs are matched with a rugged framework to provide impressive casing performance. The maximum allowable air leakage is less than 1% at +/- 8" w.g. and a maximum L/240 deflection.

Micro-organisms can flourish in drain pans when cooling-coil condensate remains there during "off" or "heating" cycles. Solution Custom units remove that condensate with a multi-sloped drain pan that ensures positive drainage. Our pan design also offers the highest level of accessibility for periodic cleaning,

General Information

now required by ASHRAE Standard 62-2001. For added protection against microbial growth, anti-microbial coatings and ultraviolet lamps are available to kill fungus and molds, minimizing allergens and allergy-causing irritants.

A complete line of filters is available for Solution Custom AHUs. For light- or pre-filtering duty, use our pleated and extended-surface filters. For higher filtration needs, 60% to 95% efficient (11 to 14 MERV ratings) rigid or bag filters can be specified. For more stringent requirements, HEPA filters and ultra-HEPA filters (15 to 16 MERV ratings) are available to trap particles as small as 0.3 and 0.1 microns respectively with 99.97% effectiveness. If odor or VOC removal is required, activated carbon filters are available as well.

ENERGY

The HVAC industry has taken a leadership role by creating energy-performance guidelines, such as ASHRAE 90.1. Solution Custom AHUs are designed with ASHRAE 90.1 in mind.

In extreme ambient conditions, heat transfer through the casing must be controlled. Our casing offers maximum thermal performance in the floors, walls and roof. To prevent energy-robbing air leaks, units are designed for a maximum casing leakage of less than 1%.

In an AHU, the fan is the largest energy consumer. Solution Custom fans offer a range of energy-saving options through fan types and controls. From lighter aluminum fan wheels to direct-drive plenum fans, which eliminate belt-and-pulley energy losses, Solution Custom AHUs can meet your needs. In addition, high- and premium-efficiency motors can be specified.

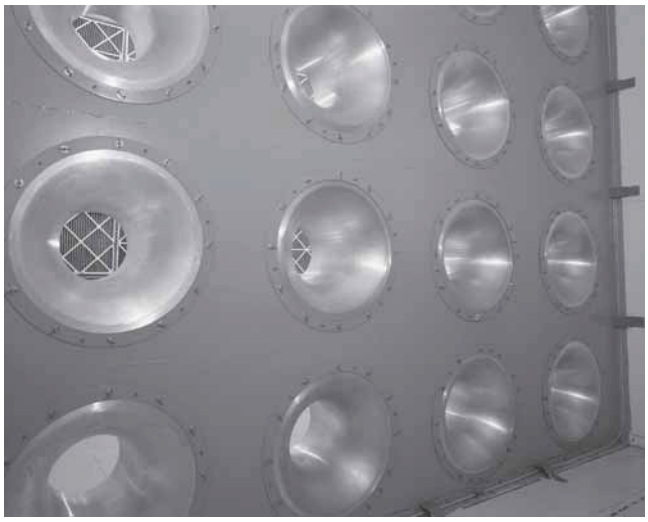
If the air system is designed for variable-air volume (VAV), YORK offers the most efficient method of VAV fan control with our Air-Modulator™ drive, which is mounted, wired and tested in our factory.

Numerous economizer configurations allow the unit to mix cool/dry outside air with the return air to cool and dehumidify the facility during spring and fall operation, reducing the need for mechanical refrigeration. All Solution Custom economizer designs incorporate an ultra-low-leak damper, or optional aluminum and insulated damper, to minimize infiltration while maintaining thermal superiority.

The exhaust airstream can represent a costly waste of energy, as conditioned air is discarded from the building. Significant energy savings can be realized by equipping Solution Custom AHUs with one or more energy-recovery options that can economically transfer sensible and latent heat between the exhaust-air and makeup-air paths.

SOUND

The air-handling system is responsible for maintaining the indoor environmental quality (IEQ) of a facility, and an important component of IEQ is acoustics. In fact, applications such as theatres, performance halls and churches may view acoustics as the most important part of IEQ. For that reason, Solution Custom AHU sound data has been collected in accordance with ARI-260, and YORK offers a variety of noise-reducing technologies.



The best way to reduce noise is not to create it in the first place. Source attenuation is the first sound-reduction method that should be considered, and is typically least expensive. Since the fan is the primary moving part in an air-handling system, it's the first place to look when reducing noise. Solution Custom AHUs are available with a nearly endless array of fan types, all custom-selected for the exacting requirements of your project. Direct-drive plenum fans can reduce vibration and drive noise by eliminating the belt-and-pulley mechanism. A range of fan-base construction and iso-

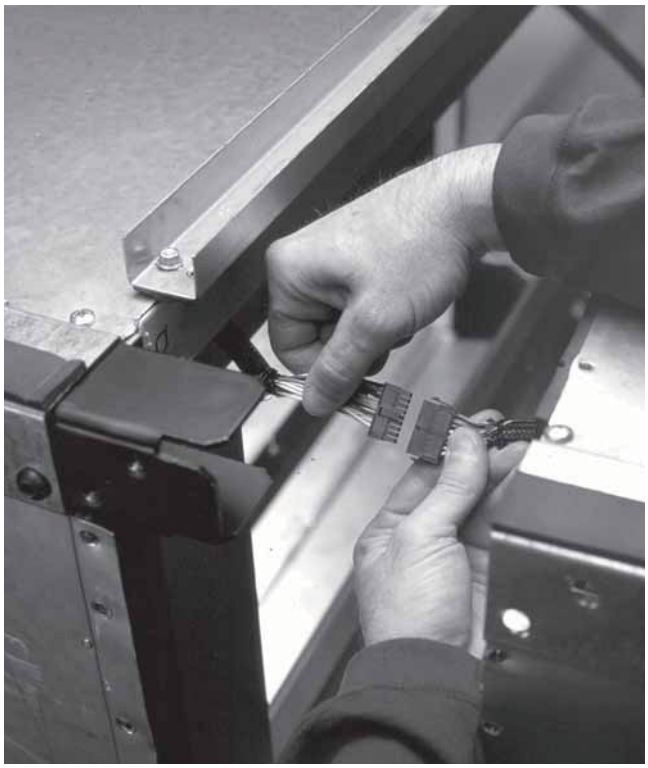
lation techniques are available to help control sound. What little noise is left can be further reduced with direct methods of sound attenuation. Using sound-absorbing walls and sound traps in the fan and discharge-plenum sections, YORK sales engineers can help you design units to meet your critical sound requirements.

CONTROLS

Higher quality and consistency are assured when YORK pre-engineers, factory-mounts, wires and commissions your Solution Custom AHU with OptiLogic™ controls. Control of humidity, carbon dioxide, temperature and pressure levels can be maintained with greater accuracy than can be achieved with field-mounted controls. All OptiLogic controls are selected to communicate with any building automation system.

All units with OptiLogic controls come with ETL approval, and are in compliance with all National Electric Codes. Also, all sensing probes and elements have been pre-engineered to determine the best mounting location, which ensures an accurate and reliable reading.

While the unit is in the factory, YORK technicians are able to gain easy access to all segments. There are no accessibility problems to cramp the quality of the job or slow down the installation process. The proper and precise installation occurs quickly and efficiently with no increase in lead-time. “Quick-connects” are utilized at all shipping splits to reduce installation and start-up time required on the jobsite.



Every Solution Custom AHU equipped with OptiLogic controls goes through a detailed, automated commissioning process before it is shipped. This extensive testing, which ensures that each control works appropriately before the unit leaves the factory, is virtually impossible to duplicate in the field.

Here is a partial list of OptiLogic end devices.

- Outside-air actuator
- Return-air actuator
- Filter differential-pressure sensor
- Mixed-air temperature sensor
- Hot-water valve and actuator
- Low-limit switch
- Chilled-water valve and actuator
- Fan differential-pressure switch
- Fan start/stop relay
- Supply-air-temperature sensor
- Fan VFD-speed input
- Duct static-pressure transducer

General Information

SEGMENT IDENTIFICATION

FAN SEGMENTS

- FS – Supply
  - Forward Curved
  - Airfoil
  - Industrial Airfoil
  - SWSI Plenum (Belt and Direct Drive)
- FR – Return
  - Forward Curved
  - Airfoil
  - Industrial Airfoil
  - SWSI Plenum (Belt and Direct Drive)
- FE – Exhaust
  - Forward Curved
  - Airfoil
  - Industrial Airfoil

COIL SEGMENTS

- CC – Cooling Coil
- HC – Heating Only Coil
- VC – Vertical Coil

HEAT SEGMENTS

- IC – Integral Face & Bypass Coil
- IG – Indirect Gas Fired Furnace
- EH – Electric Heater

ENERGY RECOVERY

- HW – Heat Wheel

FILTER SEGMENTS

- FF – Flat Filter (2" or 4")
- AF – Angle Filter (2")
- RF – High Efficiency Filter
  - Rigid Filter (12")
  - Bag Filter (21")
  - Mini-Pleat Filter (4")
- HF – HEPA Filter

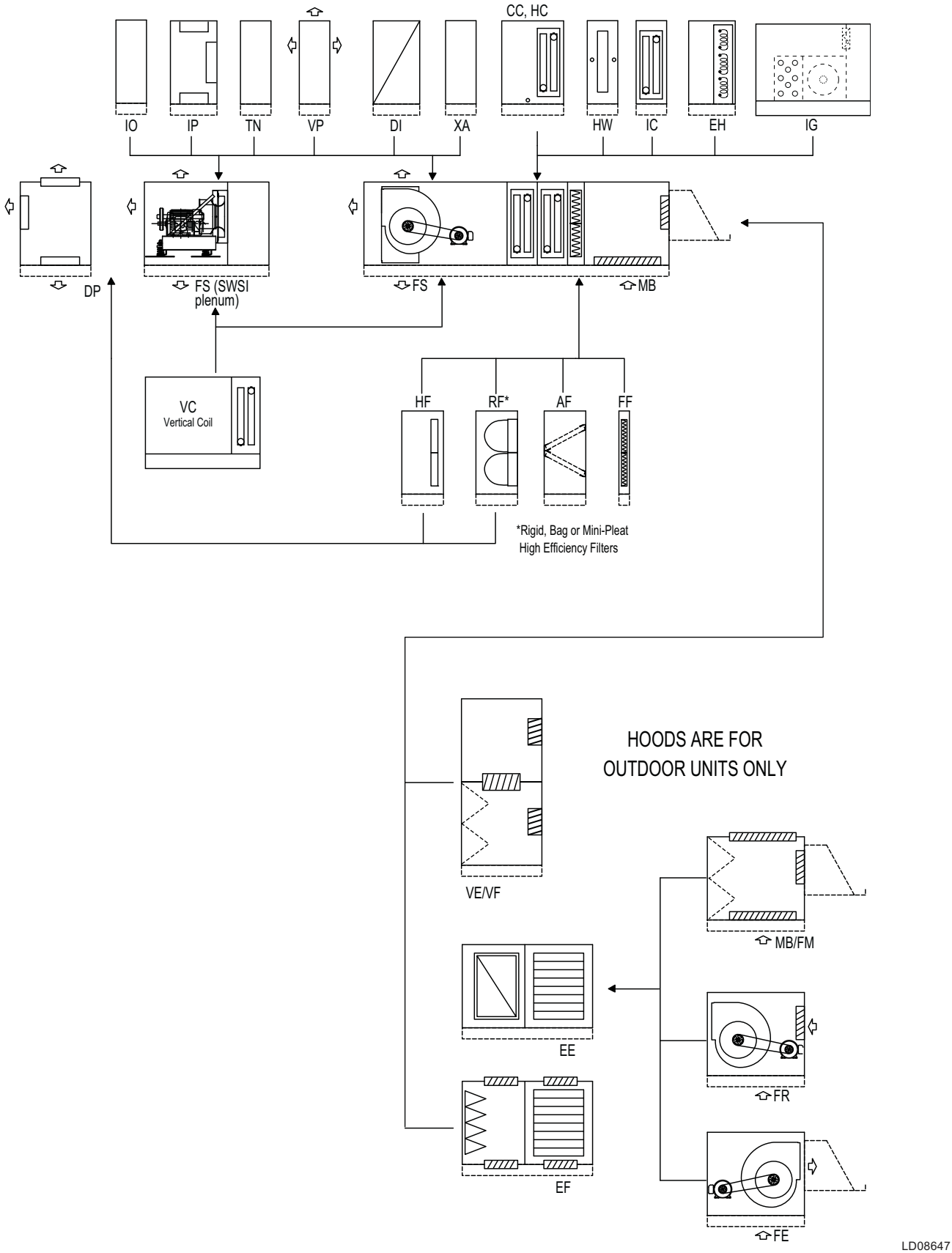
INLET SEGMENTS

- MB – Mixing Box
- FM – Filter/Mixing Box
- EF – Filter/Economizer
- EE – Economizer
- IP – Inlet Plenum
- VE – Vertical Economizer
- VF – Vertical Filter/Economizer

ACCESSORY SEGMENTS

- VP – Vertical Plenum
- DP – Discharge Plenum
- TN – Turning Plenum
- DI – Diffuser
- XA – Access segment
- IO – Inlet/Outlet

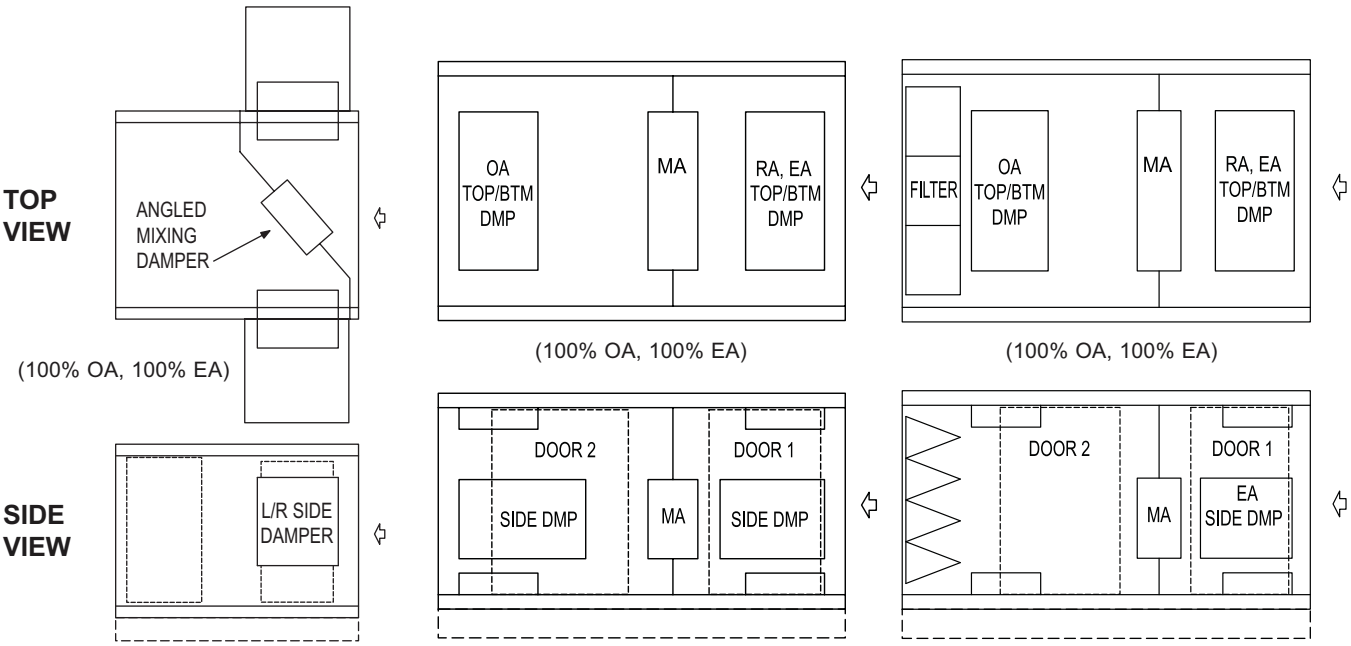
SEGMENT AVAILABILITY



LD08647

General Information

ECONOMIZER ARRANGEMENTS



EE - Economizer with angled mixing damper.

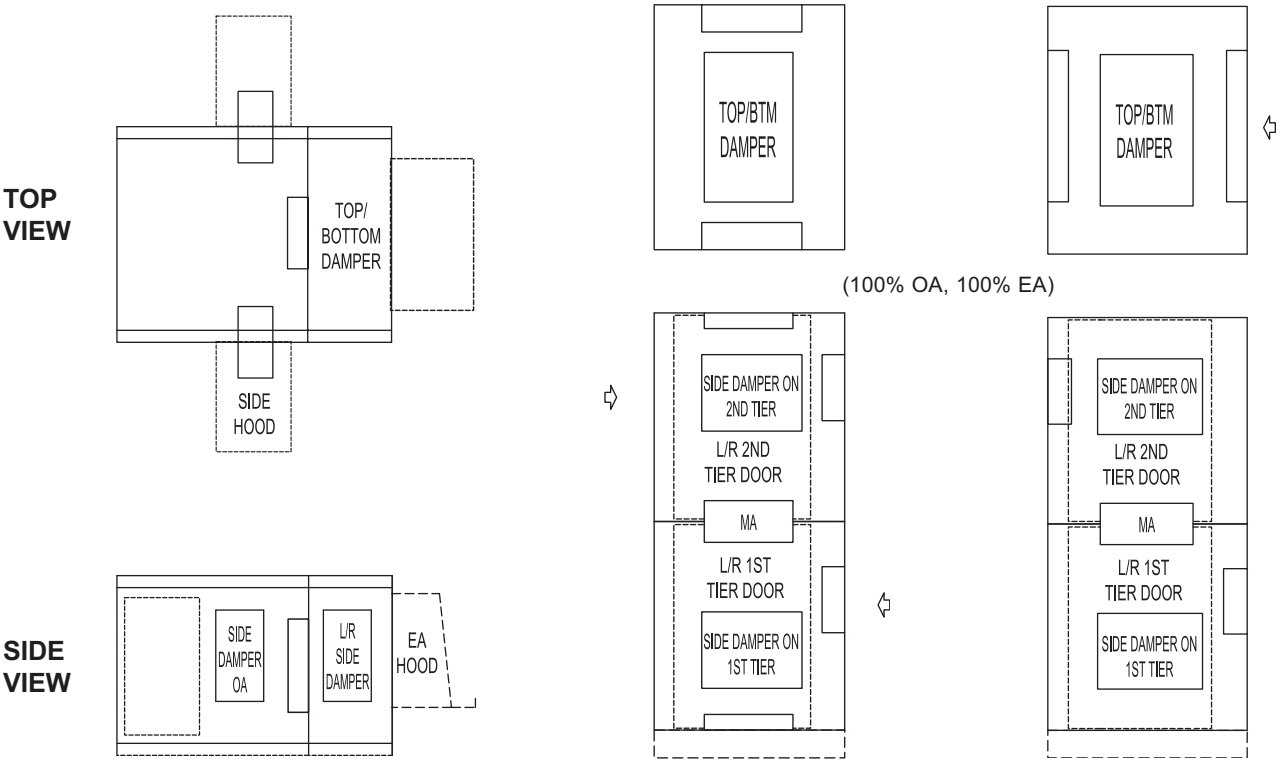
LD08032

EE - Economizer with vertical mixing damper. NOTE: Top dampers not available for outdoor units.

LD08033

EF - Filter/Economizer

LD08034



EE - Inlet/Economizer

(50% OA on each side with barometric exhaust)

LD08035

VE - Vertical Economizer

NOTE: VF (VerticalFilter Economizer) is available with filtration.

LD08036

LD08037

Unit Selection

10020b

SELECTION PROCEDURE

From the following pgs 12, 13, 23-47 and 56-61 you will be able to determine overall dimensions and weight of your SOLUTION Air Handler Unit.

You will also be able to determine the following information:

- Optimal Size (H x W) for your system CFM.
- Coil Face area, FH x FL, and nominal CFM at 500 fpm.
- Maximum fan size for each cabinet.
- Filter face area.
- Individual segment lengths.

UTILIZE THE FOLLOWING STEPS TO SELECT A CABINET.

1. Consult the Quick Select on pgs 10-13B.
2. Refine the unit size and optimize your face velocity by referring to the Coil Data table, pgs 14-16.
   Optimal Face velocity for Cooling Coil is 500 fpm.
   Optimal Face Velocity for Heating Coil is 750 - 850 fpm.
3. Consult the Fan Chart (pgs 18-19) to determine the maximum size fan allowable in the cabinet.
4. Consult the Filter Chart (pgs 20-22) for the filter face area.
5. Refer to the Segment Charts to determine overall unit length.
6. Estimate unit weight by using the Quick Select chart on pgs 12-13.

The following pages provide a sampling of sizes that we can offer. If further combinations are required, please contact your local YORK sales office.

ic Select

QUICK SELECT TOOL – OPTIMAL SIZES

CFM	H	W	COIL AREA	AF SQ. FT AREA	RF/FF SQ. FT AREA	MAX FC FAN	MAX AF FAN	MAX SWSI FAN
900	27	27	1.8	4.4	-	7x7	-	-
1500	30	33	2.9	4.0	3.3	9x9	-	-
2000	36	33	4.0	8.0	4.0	12x9	-	-
2500	33	45	5.2	8.9	6.0	10x10	-	12
3500	36	48	6.9	11.1	6.0	12x12	12	12
4500	36	60	9.2	16.0	8.0	12x12	12	14
5500	42	60	10.8	16.0	10.7	15x15	15	18
6000	42	66	12.2	18.7	10.7	15x15	15	18
7000	42	72	13.5	26.7	13.3	15x15	15	18
8000	48	72	15.6	26.7	15.0	18x18	18	25
9000	48	78	17.9	35.6	15.0	18x18	18	25
10000	51	78	19.5	35.6	18.9	20x20	20	25
11500	57	78	21.8	35.6	22.7	22x22	22	28
13500	60	84	26.5	36.0	24.0	22x22	22	28
16500	66	96	32.1	53.3	31.1	28x28	28	35
19500	66	114	39.0	57.8	38.9	28x28	28	35
22500	72	120	45.0	62.2	45.0	32x32	32	39
26500	78	126	53.4	80.0	48.3	32x32	32	44
30500	90	120	60.0	93.3	60.0	36x36	36	49
34500	96	126	67.3	106.7	64.4	40x40	40	49
38500	108	126	75.2	106.7	77.3	40x40	40	49
42500	108	138	83.1	110.0	85.3	40x40	40	49
46500	114	144	94.0	151.1	91.7	40x40	40	49
50500	120	144	98.5	151.1	91.7	40x40	40	49
51500	126	144	103.0	151.1	104.7	40x40	40	49

STANDARD LENGTH COMPONENTS

FF		10"
RF-Mini-pleat		
No Prefilter		10"
2" Prefilter		12"
RF- Bag		
No Prefilter		25"
2" Prefilter		27"
RF-Rigid		
No Prefilter		18"
2" Prefilter		20"
HF-Hepa Filter		
11.5" 99.97%		16"
11.5" 99.99%		16"
CC		
	6 ROW	19"
	10 ROW	25"
HC		
WATER	1-4 ROW	10"
STEAM	1 ROW	8"
IC		
IFB-Steam or Water	2 ROW	26"
	3 ROW	26"
	4 ROW	43"
VIFB-Steam	1,2,3 ROWS	30"
Water	1,2 ROWS	30"
EH		10"-45"

NOTE: The electric heater segment length will vary from 10" to 45", in 1" increments based upon the controls required inside the control panel.

NOTES (APPLY TO THE FOLLOWING QUICK SELECT PAGES):

1. Weights are estimates ONLY.
2. Variable baserail height is not included in overall cabinet height.
3. Pitched outdoor roof increases unit height by 2" - not included in above.
4. Roof curb, rain hood, and pipe chase weights are not included in segment weights. Contact your local YORK sales office for details on these items.
5. Access Segment (XA) is a variable length segment, from 2"-54".
6. Filter media weight is not included.
7. Cooling Coil Weights are based on 6 row, 10 fpi and 10 row, 12 fpi coils.
8. Heating Coil Weight is based on a 1 row, 10 fpi steam coil.
9. Fan segment weights include the largest available fan with the largest horsepower 230/460V motor.
10. Lengths will change as shipping splits, doors, etc. are added to unit configuration.
11. Integral face and bypass coil weights are based on copper tubes and 11 aluminum fins per inch coils.

i e S eci ic tion

PART 1: GENERAL

1.01 WORK INCLUDED

A. Indoor and outdoor air-handling units and components as shown, scheduled, and indicated on the drawings.

1.02 RELATED SECTIONS

A. The requirements of the General Conditions, Supplementary Conditions, Division 1, and Drawings apply to all work herein.

B. Requirements of the following sections apply.
   a. Section 01513 - Temporary Heating, Cooling, and Ventilating.
   b. Section 15121 - Expansion Compensation.
   c. Section 15170 - Motors.
   d. Section 15242 - Vibration Isolation.
   e. Section 15290 - Ductwork Insulation.
   f. Section 15410 - Plumbing Piping: Equipment Drains.
   g. Section 15790 - Air Coils.
   h. Section 15811 - Evaporative Humidifier.
   i. Section 15812 - Evaporative Pan Humidifier.
   j. Section 15813 - Steam Grid Humidifier.
   k. Section 15821 - Spray Coil Humidifier.
   l. Section 15860 - Centrifugal Fans.
   m. Section 15865 - Axial Fans.
   n. Section 15885 - Air Cleaning.
   o. Section 15890 - Ductwork.
   p. Section 15910 - Ductwork Accessories: Flexible Duct Connections.
   q. Section 16180 - Equipment Wiring Systems: Electrical Characteristics and Wiring Connections.

1.03 QUALITY ASSURANCE

A. Manufacturers: The design shown on the drawing is based upon products of the manufacturer scheduled. Alternate equipment manufacturers will be acceptable if equipment meets the scheduled performance and complies with these specifications. The intent of this specification requirement is to assure that the products are delivered through a quality system and framework that will assure consistent quality. If equipment manufactured by manufacturer other than that scheduled is utilized, then the Mechanical Contractor shall be responsible for coordinating with the General Contractor and all affected Subcontractors to ensure proper provisions for installation of the furnished unit. This coordination shall include, but not be limited to, the following:
   a. Structural supports for units.
   b. Piping size and connection/header locations.
   c. Electrical power requirements and wire/conduit and overcurrent protection sizes.
   d. The Mechanical Contractor shall be responsible for all costs incurred by the General Contractor, Subcontractors, and Consultants to modify the building provisions to accept the furnished units.

1.04 REFERENCES

A. AMCA 99 – Standard Handbook.

B. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes.

C. AMCA 300 – Test Code for Sound Rating Air Moving Devices.

D. AMCA 301 – Method of Publishing Sound Ratings for Air Moving Devices.

E. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters.

F. ANSI/AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.

G. ANSI/UL 900 – Test Performance of Air Filter Units.

H. ARI 410 – Forced-Circulation Air Cooling and Air Heating Coils.

I. ARI 430 – Standard for Application of Central-Station Air Handling Units.

J. ARI 260 – Sound Rating of Ducted Air Moving and Conditioning Equipment.

K. NFPA 90A – Installation of Air Conditioning and Ventilation Systems.

L. SMACNA – Low Pressure Duct Construction Standards.

M. AMCA 611-95 – Methods of Testing Airflow Measurement Stations for Rating.

N. ASHRAE 52.1/52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.

O. ASHRAE 62 – Ventilation for Acceptable Indoor Air Quality.

P. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section_____.

B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.

C. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, gages, and finishes of materials.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

F. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

G. Submit manufacturer's installation instructions under provisions of Section_____.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section_____.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.07 RATINGS AND CERTIFICATIONS

A. Conform to AMCA 210 for fan performance ratings.

B. Conform to E.T.L. or U.L. standards.

C. Conform to ARI 410 for capacities, pressure drops, and selection procedures of air coils.

D. Conform to ARI 430 for all fabrication procedures of air handling units.

E. Utilize only ANSI/UL 900 listed Class I or Class II filter media, approved by local authorities.

F. Utilize only ISO9001, 9000, or 9002 certified facilities in the manufacturing of the air- handling unit.

G. Electric control wiring shall be in accordance NEC codes & ETL requirements

H. Motors shall satisfy the Federally mandated Energy Policy Act (EPACT).

I. Test Airflow Monitoring Stations in accordance with AMCA 611-95. Provide Certified Ratings Seal for Airflow Measurement Performance.

1.08 DELIVERY, STORAGE AND HANDLING

A. All handling and storage procedures shall be per manufacturer's recommendations.

B. Unpainted units shall be shrink-wrapped by the manufacturer prior to shipment to prevent damage due to weather and road debris during transportation and thereafter while in storage awaiting installation. Alternatively, units may be completely covered by tarps while in transit or shipped in an enclosed truck. Units not factory shrink-wrapped shall be re-covered by the contractor at the job- site while awaiting installation. Protection of the complete unit for avoidance of general rusting must be handled as best suits the circumstances. Store in a place protected from construction traffic and handle carefully to avoid damage to components, enclosures, and finish.

C. All openings shall be protected against damage from shipping

D. Safety warning labels shall be clearly marked in 3-language format

E. Filters will [ship loose from factory with unit] or [require call for delivery] as scheduled.

F. All loose-shipped items need to be packed, protected and secured with the air units.

G. Pipe chases will ship attached to the unit as indicated on the drawings unless the total unit width including the pipe chase exceeds 102", in which case the pipe chase will ship loose.

H. Rain hoods will [ship loose] [ship attached to the unit] as indicated on the drawings.

I. Factory Packaged Controls (FPC) will be factory mounted or shipped loose as selected. Motor control devices will be factory mounted or shipped loose as selected and indicated on the drawings. Electronic equipment cannot be stored in wet or damp areas even though they are sealed and secured.

J. Motors should be protected and inspected in accordance with the manufacturers specific instructions regarding periods of long storage.

1.09 WARRANTY

A. The manufacturer's standard warranty shall be for a period of eighteen months from the date of shipment.

Warranty is limited to manufacturers defect only.

The warranty shall include parts (18 mo.) and labor (12 mo.) during this period.

A factory trained and factory employed technician shall be available within 50 miles of the job site to respond to a service call.

The warranty shall not include parts associated with routine maintenance, such as belts, air filters, etc.

Warranty is not extended to any alteration, modifications or external component attached to “original” equipment “as-built” and shipped from manufacturing facilities.

All factory provided controls will carry the “Limited Warranty” as described above.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. Manufacturers “start-up” requirements must be complied-with to ensure safe and correct operation.

1.11 EXTRA STOCK

A. Provide one spare set(s) of filters per unit.

B. Provide one set of spare fan belts for each unit.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. York Solution (Basis of design).

B. _____

C. _____

2.02 GENERAL DESCRIPTION

A. Factory manufactured air-handling units designed to the performance levels specified with a combination of air-handling components in unitized housings to form complete, integrated machines as indicated on the drawings.

B. Fabricate air-handling units suitable for the scheduled capacities.

C. Factory test and balance fan design and drives to limit vibration (displacement in mils) at operating speeds.

D. Base performance on sea level conditions or [altitude].

E. All internal components specified in the air handling unit schedule shall be factory furnished and installed. Unit(s) shall be completely factory assembled.

G. Unit(s) shall ship in one (1) piece whenever possible. Unit splits will be provided only where necessary for shipping [or where indicated by customer]. Lifting lugs will be supplied on each side of a shipping split and at all unit corners to facilitate rigging and aid in joining shipping sections. Lifting lugs to be suitable for rigging without requiring additional support frames.

2.03 UNIT CASING

A. The air-handling unit shall be specifically designed for use in an indoor or outdoor application, as specified.

B. The construction of the air handling unit shall consist of a complete structural frame with removable panels. Casing shall be supported in such a manner so that maximum allowable air leakage shall not exceed 1% and panel deflection shall not exceed a L/240 ratio when subjected to +/- 8-in. w.g. static pressure. All panels shall be completely gasketed prior to shipment and shall be completely removable for unit access and removal of components. Removal of any or all panels shall not affect the structural integrity of the unit.

C. The air-handling unit shall be provided with a full perimeter base rail channel.

   a. The base rail channel shall be formed of 16-gage minimum galvanized steel.

   b. The base rail channel shall have a minimum height of [3] [6] [8] [10]" to insure adequate clearance for drain pipe trapping.

   c. The base rail channel shall support all major components.

   d. Perimeter structural steel lifting lugs shall be provided to accommodate overhead lifting.

D. The air-handling unit shall be supplied with double wall panels for walls, roof, and floor constructed of G90 mill galvanized sheet steel.

E. Outdoor air handling unit(s) shall be provided with a full-perimeter, gasketed [insulated] roof curb. Roof curb shall ship loose for field installation prior to unit placement.

   a. Roof curb shall be a prefabricated galvanized steel-mounting curb.

   b. Roof curb application shall provide for continuous insulation between unit panels and roof curb.

   c. The roof curb shall have 1.5-inch, 3 pound per cubic foot density fiberglass insulation**.**

   d. Roof curb shall be a perimeter type providing complete perimeter support of the air-handling unit.

   e. Roof curb shall be flat or sloped to accommodate

the roof pitch, as indicated on the curb drawings.

f. The curb shall be a minimum 18 gage and a minimum of 14 inches high.

g. Gasketing shall be provided for field mounting between the unit base and the roof curb.

h. The curb shall include a 1" x 4" wood nailer.

F. Outdoor air handling unit(s) shall be provided with an external, double wall construction, insulated pipe-chase to fully contain field piping and valves. Pipe-chase must provide sufficient space for coil connections and piping to be installed without interference. Pipe-chase enclosures of adjacent segments shall be combined to be a continuous open pipe-chase.

a. Pipe chase shall be [24"] [36"] [48"] in nominal depth, with an internal clearance of 2" less than nominal dimension.

b. Pipe chase wall and floor construction shall be the same as that of the unit.

G. The air handling unit casing shall be constructed of 2" thick double wall roof panels, floor panels, and wall panels having exterior construction of [20] [18] [16] gage G90 galvanized steel. The interior lining shall be a solid lining of minimum 20 gage [minimum 20-gauge 304 stainless steel solid or .080" thick aluminum perforated lining in specific segments as indicated.] Exterior casing screws shall be zinc chromate coated.

H. Floor panels shall be double wall construction, designed to provide at most L/240 deflection based on 300 lb. concentrated load at mid-span. The interior liner of the floor panels shall be a solid lining of minimum 20 gage galvanized [304 stainless steel].

An additional 0.125" aluminum diamond tread plate liner shall be provided as a walk-on surface in unit access areas.

I. The outdoor air-handling unit shall be supplied with a double-sloped roof to promote drainage of precipitation and prevent standing water.

a. Roof construction design shall accommodate a minimum snow-load of 30 lb/ft$^{2.}$

b. The roof shall have a minimum pitch of 1/4" per foot.

c. The roof shall overhang all side and end panels to prevent precipitation drainage from streaming down the unit wall panels.

d. Outdoor units supplied with flat roofs shall not be acceptable.

J. The air-handling unit shall be completely insulated throughout all panels and structural frame members with spray injected foam to thoroughly insulate and seal the air unit structure. Openings in structural channels shall be covered. If structural channels are not internally insulated, then structural channels must be wrapped with an armaflex type insulation to maintain unit thermal performance and prevent sweating. Any portion of the unit that is not insulated (gaps) or has less than 2" of insulation shall be the responsibility of the contractor to modify.

a. Insulation shall be a full 2" throughout the entire unit.

b. Units with less than 2" of insulation in any part of the walls, floor, or roof shall not be acceptable.

c. Insulation application shall conform to NFPA 90A requirements.

d. Panels shall have a minimum thermal conductivity R of 12.5 (Hr-Ft2-°F/BTU).

e. For outdoor units all pipe chases, coil header panels and return bend panels shall be fully insulated.

f. Panels with perforated panel liner shall utilize a triple-wall construction, joining a matte-faced fiberglass insulated panel with a foam insulated panel to achieve both superior thermal performance and sound attenuation.

g. All drain pans shall have double-wall construction and be insulated with spray injected foam. Fiberglass insulation is not acceptable.

K. Double wall access doors shall be provided on sections as scheduled. Doors shall be of the same material type as the wall panels. A bulb-type gasket shall be provided around the entire door perimeter. Industrial style stainless steel hinges shall permit a complete 180 degree door swing. All doors shall open against positive pressure. Alternatively, if doors opening against positive pressure are not available, a safety chain mechanism and warning labels shall be provided to prevent injury to maintenance personnel.

a. Access door must be of the same material type as exterior/interior casing.

b. Access door latches shall utilize a roller cam latching mechanism to insure maximum sealing. Latches featuring a rotating “paw” are not acceptable.

c. Access doors shall be provided with a single door handle linked to multiple latching points. Stacked indoor units shall insure door handles are positioned at the lowest possible point of the top tier segments for convenient access.

d. Doors serving access areas shall be provided with inside operable door latches.

e. Unit access doors shall be provided with a locking hasp to accommodate a combination/pad lock.

f. Unit access doors shall be provided with a keylock. All access doors shall be operated by the same key.

L. Viewing windows shall be provided as shown on the schedule. All windows shall be double-pane tempered glass.

M. Provide auxiliary drain pans in segments as indicated on the schedule.

a. The auxiliary pans shall be double sloped, positive draining with galvanized [stainless] steel liner and double wall construction with drain connection of like material, draining to one side of the unit.

b. Coat auxiliary drain pans with a [mastic] [antimicrobial] coating.

c. Drain connection shall be welded to the drain pan. If threaded screw-type joint is used, all joints must be easily accessible for inspection and service.

2.04 FANS

A. Fans shall be Class I, II, and III, as scheduled, selected to provide the airflow and pressure specified.

B. Fan segments shall be equipped with [double width double inlet (DWDI) housed fans] or [single width single inlet (SWSI) plenum fans as scheduled.] Double width double inlet (DWDI) fans shall be industrial grade, having airfoil or forward curved blades as scheduled. All single width single inlet fans (SWSI) fans shall have airfoil (AF) blades. Flat plate blades shall not be acceptable.

C. All airfoil fans shall bear the AMCA Seal. Airfoil fan performance shall be based on tests made in accordance with AMCA standards 210 and comply with the requirements of the AMCA certified ratings program for air and sound. In addition, all airfoil wheels shall comply with AMCA standard 99-2408-69 and 99-2401-82.

D. SWSI fans shall be provided with [inlet screens, fan screens and belt guards.] DWDI fans shall be provided with [inlet screens] as specified.

E. Industrial grade DWDI airfoil fans shall be provided with an optional access door in the fan scroll.

F. Fans shall have polished steel shafts sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class. Close tolerances shall be maintained where the shaft makes contact with the bearing. Shaft shall be factory coated after assembly with an anti-corrosion coating.

G. After the pre-balanced fan is installed on the fan skid and isolator rails, the entire fan skid shall be run-balanced at the specified speed to insure smooth and trouble-free operation. The run balance shall include filter-in and filter-out balancing in all three (3) planes, on both sides of the fan assembly at the bearings.

a. Filter-in measurements shall be taken in the horizontal and vertical planes on the drive and opposite-drive sides of the fan shaft.

b. Filter-out measurements shall be taken in the horizontal, vertical and axial planes on the drive and opposite-drive side of the fan shaft.

H. The fan motor and fan-assembly shall be internally mounted. The fan motor and fan-assembly shall be mounted on a common base to allow consistent belt tension with no relative motion between the fan and motor shafts. The common base shall be isolated on a full width isolator support channel using 1" [2"] springs [with seismic restraints].

a. Fan motor and drive shall be contained within an OSHA-compliant belt guard.

b. The fan motor shall be on an adjustable base.

c. The fan discharge shall be connected to the cabinet through a canvas flexible connection to insure vibration-free operation.

d. Thrust restraints shall be provided as specified to mitigate fan assembly vibration in the horizontal plane.

e. Fan segments shall be equipped with an access door located on [drive side, opposite drive side, both sides] of the segment.

f. Fan sections shall be equipped with safety screens covering bottom inlets and discharge openings, sufficient to hold 300 lb. service person with minimal deflection.

g. Fan assemblies shall be balanced for inverter duty operation.

h. The fan will be balanced over the entire range of fan operation (30% to 100% of RPM).

2.05 BEARINGS AND DRIVES

A. Fan bearings shall be designed for an average life (L50) of at least 200,000 hours [an L10 life of at least 200,000 hours].

B. Plenum fans shall be [belt-driven] or [direct-drive].

C. All re-greaseable bearings shall be factory lubricated and equipped with standard hydraulic grease fittings and lube lines extended [to the motor side of the fan] [to the exterior of the unit]. Re-greasable bearings provided without factory installed lubrication lines are unacceptable.

D. Fan drives shall be selected for a 1.5 service factor and anti-static belts shall be furnished.
   a. [All drives shall be fixed pitch] [All drives 15 hp or smaller on constant volume units shall be adjustable pitch. Drives 20 hp or larger or any drives on units equipped with VFDs shall be fixed pitch].
   b. [All fans with motors 10 HP or larger shall be equipped with multiple belt drives].
   c. Sheaves shall be machined from a close grain cast iron and statically balanced by the manufacturer. A fixed pitch sheave shall be provided on the motor.
   d. Drive belts shall be a V type. All drive belts shall be precision molded raw edge construction. Belts shall be oil and heat resistant.

2.06 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Fan motors shall be furnished in sizes, electrical power and starting characteristics as shown in the schedule.
   a. All fan motors will be built in accordance with the latest standards of the National Electrical Manufacturer's Association (NEMA) and IEEE and shall be rated for continuous duty at full load at 40°C ambient temperature rise and a service factor of 1.15.
   b. Fan motors shall be NEMA design ball bearing type.
   c. Fan motors shall be 1750 RPM [1500 RPM], [open drip proof], or [totally enclosed, fan cooled type] [as indicated on the schedule].
      1. Direct drive plenum fans shall be coupled with appropriately sized motors to nearly match synchronous motor speed, as detailed in the schedule.
   d. All fan motors shall be [high] or [premium] [unless otherwise scheduled] efficiency.
   e. Motors shall be [suitable for use in variable frequency application, per NEMA MG-1 Part 30] or ["inverter ready", complying with *NEMA STD MG1 PART 31.4.4.2*].

B. Variable-air-volume units shall be equipped with factory mounted and [wired] variable frequency drives serving [supply] [supply and return/exhaust] for fan unloading control. Wiring to motor shall be provided in flexible conduit.
   a. Each drive shall be mounted in a dedicated, NEMA 1 compartment located on the side of its associated fan section. Outdoor units shall encase controls in a weatherproof control enclosure.
   b. After the air unit is installed, the VFD shall be field commissioned by a factory trained and employed service technician.
   c. The VFD shall be UL listed and comply with all applicable provisions of the National Electric Code. The VFD shall include the following features:
      1. Multi-line, multi-lingual alphanumeric display for operator control, parameter set-up and operating data. Display data includes output frequency (Hz), speed (RPM), motor current, calculated % motor torque, calculated motor power (kW), DC bus voltage, output voltage, heatsink temperature, elapsed time meter (re-settable), kWh (re-settable), input / output terminal monitor, PID actual value (feedback) & error, fault text, warning text, and scalable process variable display, Hand-Off-Auto and speed selection.
      2. Integral input reactor(s) – equivalent 5% impedance.
      3. Modbus RTU, Johnson N2, Siemens FLN as standard communications, with options for BACnet and LONworks.
      4. Two (2) analog inputs.
      5. Six (6) programmable digital inputs.
      6. Two (2) programmable analog outputs.
      7. Three (3) programmable digital relay outputs.
      8. Adjustable filters on analog inputs and outputs.
      9. Input speed signals, including current 0(4)-20 mA, voltage 0(2)-10 VDC, Accel/Decel contacts (floating point control), RS-485 Modbus, Johnson N2 , Siemens FLN, BACnet and LONworks communications.
      10. Start/Stop options shall include 2 wire (dry contact closure), 3 wire (momentary contacts), application of input power, and application of reference signal (PID sleep/wake-up).
      11. Protection circuits shall include overcurrent, ground fault, overvoltage, undervoltage, overtemperature, input power loss of phase, loss of reference/feedback, adjustable current limit regulator, UL 508C approved electronic motor overload (12t).
      12. Premagnetization on start.
      13. DC braking/hold at stop.
      14. Auto restart shall be customer selectable and adjustable.
      15. Ramp or coast to stop.
      16. Seven (7) preset speeds.
      17. Three (3) critical frequency lockout bands.
      18. Start function shall include ramp, flying start,

automatic torque boost, and automatic torque boost with flying start.

19. Integral RFI/EMI filtering to meet EMC EN61800-3 First Environment Main disconnect.

Constant volume units shall be equipped with factory mounted and [wired] or motor starter panel(s) serving [supply] [supply and return/exhaust] fan motor(s). Wiring to motor shall be provided in flexible conduit (if any).

a. The motor starter panel(s) and all associated components shall be U.L. listed.

b. The motor starter panel shall be protected by an environmental enclosure per ETL rating enclosure.

c. Individually protected supply fan starter with short circuit and overload protection.

d. 115 volt control power transformer with primary and secondary protection.

e. The starter panel shall be provided with a 5 point terminal strip for field connections.

f. An integral [non-fused] [fused] main power-disconnect shall be provided.

1. The disconnect shall be an integral part of the motor starter panel.

2. The disconnect shall be factory wired.

D. The motor starter panel shall contain a main power block, single speed fan motor contactor(s) with overload device(s), three phase ambient compensated overload heater elements, two primary control fuses, one secondary control line size fuse, terminal strip, and a door-mounted on/off auto switch.

E. The air-handling unit shall be equipped with factory mounted and [wired] or [wired with flexible conduit] external [non-fused] [fused] disconnect in a separate NEMA [1, 12, 3R] enclosure.

F. The air-handling unit shall be power wired for a single point connection. All power loads to be wired to one point of power source entrance.

G. The air-handling unit shall be power wired for independent power source for receptacle and lights, having[one switch] or [multiple switches for independent light control], separate from the Motor power source entrance. Lighting circuit shall receive power from a “Dedicated Circuit Breaker” — remotely provided by others.

H. [120V Incandescent Light] [120V Fluorescent Light] shall be provided in segments as indicated on the schedule.

I. External light switch shall be provided with a 1 hour timer device on Fan segment.

J. Individual (internal) light switches to operate individual lights shall be provided as scheduled.

K. 120V convenience outlet(s) shall be provided as scheduled.

2.07 HEATING/COOLING COMPONENTS

A. Coil segment length shall be optimized to contain selected coil(s), spacer(s), and optional access doors. Coils shall be selected to maximize unit tunnel area using [single] or [stacked] coil arrangements as needed to satisfy required coil face areas.

a. Coil segment design and coil selection shall not require a drain pan in any downstream section to contain the coil condensate.

b. All cooling and/or heating coils shall be furnished to meet the performance requirements set forth in the schedule.

c. All water and steam coils shall have performance certified in accordance with ARI Standard 410 for coil capacity and pressure drop.

d. Coils used with glycol are outside the scope of ARI-410, but shall be selected to meet scheduled performance.

e. All coils must be circuited to operate at design load with water velocity within the ARI range of certified rating conditions.

f. Multiple coils in a single coil segment shall be separated by [galvanized steel] [stainless steel] coil spacers. Coil spacers should accommodate side-access via a removal side-plate.

g. [Coil segment side and top panels (indoor units)] [Coil segment side panels (outdoor units)] shall be removable to allow for removal and replacement of coils, without affecting the structural integrity of the unit.

h. Upstream and downstream segment door clearances shall accommodate a minimum 2-inches of field installed external piping insulation.

i. Coil segment shall accommodate full-face height or reduced face height coils, as specified.

B. Cooling Coil Segment shall be provided with a full-width, multi-sloped (IAQ) drain pan that extends downstream a minimum 6” beyond the last coil in the section to provide drain pan access for cleaning and inspection.

C. Drain pan design and application shall comply fully with the stated intent of ASHRAE 62-2001.

D. Drain pans shall be sloped in a minimum of 2 planes; cross break interior pans and pitch toward drain

connections to ensure complete condensate drainage. Units with cooling coils shall have drain pans under complete cooling coil section. A minimum of 1" clearance shall be provided from the bottom of the coil casing to the drain pan so that the drain pan can be visually inspected and physically cleaned, including underneath coil, without removal of the coil. All drain pan connections will be to one side of the unit to enable proper trapping. Drain pans that do not comply with these maintenance requirements will be the responsibility of the contractor to field modify.

E. The drain pan shall be of double wall construction with a minimum 20 gage galvanized [stainless steel] liner and shall be insulated with spray-injected foam to completely seal the drain pan assembly. Fiberglass insulation is not acceptable.

F. The drain pan liner shall have a [mastic] [anti-microbial] coating.

G. Drain pan shall be provided with a minimum 1-1/4" MPT condensate connection positioned beneath the lowest point of the drain pan. Drain connection shall be welded to the drain pan and shall match the drain pan liner material type. If threaded screw-type joint is used, all joints must be easily accessible for inspection and service.

H. All coils shall be slide out, “shipping” type, mounted on tracks, and easily removable from the air handling unit by removing only one exterior panel. Coils that require additional disassembly of the unit or replacement of the entire coil section (e.g. “unit” type coils) for coil removal are unacceptable.

I. Coils shall be supported by galvanized [stainless steel] coil support members, constructed of channeled members, allowing uninhibited access for inspection and safe cleaning.

J. All vertical coil supporting members (bulkheads) and blockoffs shall be constructed of galvanized steel [stainless steel] and shall entirely seal off the coil, preventing air bypass.

K. Coil grommets shall be provided on all coils to completely seal the area between the coil connection and the unit casing.

L. Drainable Water coils shall be designed to operate at 250 psig design working pressure and up to 300° F and shall be tested with 325 psig compressed air under water. Circuiting shall provide free and complete draining and venting when installed in the unit. All vent and drain connections shall be extended to the outside of the unit casing.

M. Direct expansion coils shall be designed to conform to the ANSI B9.1 (Safety Code for Mechanical Refrigeration) when operating with a refrigerant pressure not exceeding 250 psig and shall be tested with 325 psig compressed air under water. The completed coil shall be dehydrated, including headers, return bends and distributors and sealed for shipment. Each coil shall be furnished with a brass distributor with solder-type connections. Suction and discharge connections shall be on the same end regardless of rows deep. Direct expansion liquid lines should be extended to outside of unit. All refrigerant specialties should be mounted outside of unit.

N. Steam Distributing (1" O.D.) coils shall be designed for operation at 100 psig pressure and a corresponding saturated steam temperature of 338° F. Coils shall be tested with 315psig compressed air under water. The outer tube shall be 1" O.D. and the inner distribution tube will be 5/8" O.D. The circuiting shall be of a non-trapping condensate drainable design facilitating gravity drain. The steam shall discharge in the direction of condensate flow to ensure even distribution and heat transfer through the full length of each tube.

O. The primary surface shall be 5/8" O.D. or 1/2" O.D. copper tube, staggered in direction of airflow. Tubes shall be mandrel expanded to form fin bond and provide burnished, work-hardened interior surface. The tubes shall have a minimum tube wall thickness of [0.020"] [0.025"] [0.035"] for 5/8" O.D coils and [0.016"] [0.020"] [0.032"] for 1/2" O.D. coils. Specified thickness shall be maintained throughout the tube including brazed U-bends.

P. Extended surface shall consist of die-formed, continuous, [aluminum] [copper] [corrugated] enhanced performance fins. The fins shall have fully drawn collars to accurately space fins, and to form a protective sheath for the primary surface. The fin thickness shall be [0.006"] [0.010"].

Q. Coils with finned height greater than 48 inches shall have an intermediate drain pan extending the entire finned length of the coil. Cooling coils in excess of 48 inches in height shall not be acceptable unless provided with an intermediate drain pan. The intermediate pans shall have PVC [copper] down spouts to guide condensate to the main drain pan.

R. Coil casing shall be constructed of 16-gauge galvanized steel [stainless steel]. Tube sheets on each end shall have drawn collars to support tubes. A single intermediate coil support shall be provided on coils with a finned length of more than 62 inches, two (2) intermediate supports above 100 inches in length, and three (3) intermediate supports on coils with a finned length of more than 141 inches. Cas-

ing channels shall be free-draining, without depressions to collect moisture and contaminants. Casing channels shall not block fin area.

S. Headers shall be of heavy seamless copper] [red brass] tubing, silver-brazed to tubes. Connections shall be of steel [red brass], with male pipe threads, silver-brazed to the headers. A 1/4" FPT, plugged vent or drain tap shall be provided on each connection. All vent and drain connections shall be extended to the outside of the unit casing.

T. Coil shall be protected with a [Phenolic], [Heresite®], [Electrofin] [flexible dip and baked epoxy coating].

U. Circuiting shall be to provide free draining and venting, through one vent and one drain on each coil, when installed with casing level. Coils shall be circuited, and have connections arranged, for counterflow of air and water with supply on bottom and return on top of coil headers. Coil circuiting shall provide for design water velocity in tubes without exceeding total water pressure drops in schedule.

V. Coils using turbulators are unacceptable.

2.08 FILTERS

A. Filters and filter segments shall be provided as scheduled. Filter tracks shall be constructed of galvanized steel and be built as an integral part of the unit. Filter media shall be listed Class 2 or Class 1 under U.L. Standard 900 as required by local codes.

B. **Flat Filter (FF) segment** shall be provided with throwaway (2")], permanent cleanable (2"), or 30% pleated **(2" or 4")** as scheduled.

C. **Angle Filter (AF) segment** shall be provided with throwaway (2"),permanent cleanable (2"), or 30% pleated **(2")** as scheduled.

D. **High Efficiency Filter (RF) segment** shall accommodate [4"] [12"] [22"] media.

   a. Media shall be 4" mini-pleated (60-65% efficiency-MERV 11 (80-85% efficiency-MERV 13 (90-95% efficiency-MERV 14**,** or as scheduled.

   b. Media shall be 12" rigid (60-65% efficiency-MERV 11 (80-85% efficiency-MERV 13 (90-95% efficiency-MERV 14 or as scheduled.

   c. Media shall be 22" bag (60-65% efficiency-MERV 12 (80-85% efficiency-MERV 14 (90-95% efficiency-MERV 15 or as scheduled.

   d. Prefilter media shall be throwaway or permanent cleanable or 30% efficient. Spare sets of media shall be provided as scheduled.

E. **HEPA filter sements** (HF) shall be provided with MERV 17 (99.97% efficient) [18(99.99% efficient) Manufacturer's HEPA filter system design shall be confirmed by independent, 3rd party performance testing to meet or exceed the scheduled efficiencies per I.S. Military Standard MIL-STD282 and Institute of Environmental Scienes and Technology Recommended Practice IEST-RP-CC001.3.

2.09 DAMPERS

A. Dampers will be of ultra-low leak design having airfoil blades. The damper blades shall be provided with extruded vinyl edge seals and flexible metal compressible jamb seals. Outside air and Exhaust Air dampers shall have leakage not exceeding 4 CFM/square foot at 1" w.g., complying fully with the requirements of ASHRAE 90.1. Damper blades shall be parallel acting [opposed acting].

2.10 APPURTENANCES

A. **Mixing box (MB) segment** shall be supplied as indicated on the drawings. Mixing Box segment(s) shall be supplied with air inlets optimized to achieve mixing of outside air and return air.

   a. The inlet segment shall have outside and return airstreams directed into each other by damper assemblies to facilitate mixing of the airstreams, or return air connection only, or outside air opening only as indicated on the schedule.

   b. Outside air rain-hood with "bird screen" will be provided for outdoor applications. Rain hood shall be outfitted with a moisture eliminator to channel moisture away from the air being drawn into the unit. Return air opening shall be sized for 100% of unit airflow.

   c. The return air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max] [25%/75% split].

   d. The outside air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max] [25%/75% split].

   e. A factory installed safety screen shall be provided over all bottom inlet openings, sufficient to hold 300 lb. service person with minimal deflection.

   f. The airflow monitoring station must be tested for pressure drop in accordance with AMCA Stan-

dard 611-95 in an AMCA registered laboratory. The airflow monitoring station must bear the AMCA Certified Ratings Seal for Airflow Measurement Performance.

B. **Filter/Mixing box (FM) segment** shall be provided with combination Filter/Mixing Box combining the filtering and mixing functions in one segment.
   a. Segments shall be designed to accommodate 2" angled filter media. The filter media shall be side-loading.
   b. A magnahelic differential pressure gauge shall be factory installed and flush mounted to measure the pressure drop across the filter bank.
   c. The return air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max [25%/75% split].
   d. The outside air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max [25%/75% split].
   e. The airflow monitoring station must be tested for pressure drop in accordance with AMCA Standard 611-95 in an AMCA registered laboratory. The airflow monitoring station must bear the AMCA Certified Ratings Seal for Airflow Measurement Performance.

C. **Flat Filter (FF) segment** shall be designed to accommodate 2" [4]" media. The filter shall be side loading.
   a. A magnahelic, differential pressure gauge shall be factory installed and flush mounted to measure the pressure drop across the filter bank.

D. **Angle Filter (AF) segment** shall be designed to accommodate (2") media. The filter shall be side loading.
   a. A magnahelic differential pressure gauge shall be factory installed and flush mounted to measure the pressure drop across the filter bank.

E. **High Efficiency Filter (RF) segment** shall be designed to accommodate [4 inch mini-pleat] [12 inch rigid] [21 inch bag] filter media. The prefilter depth shall be [2"] [4"].
   a. Filters shall be side [front or rear] loading, as indicated in the schedule.
   b. A magnehelic differential pressure gauge(s) shall be factory installed and flush mounted to measure the pressure drop across the [prefilter only] [final filter only] [combination prefilter and final filter][prefilter and final filter separately].

F. **Heating Coil (HC) segment** shall be supplied as indicated on the drawings.
   a. The outdoor unit shall have a pipe chase with a nominal depth of [24] [36] [48] inches.

G. **Cooling Coil (CC) segment** shall be supplied as indicated on the drawings.
   a. The outdoor unit shall have a pipe chase with a nominal depth of [24] [36] [48] inches.

H. **Vertical coil (VC) segment** shall be supplied as indicated on the drawings.

I. **Turning (TN) segment** shall be supplied as indicated on the drawings.

J. **Economizer (EE) segment** shall be supplied as indicated on the drawings. Economizer segment(s) shall control mixing of outside air and return air through the use of modulating economizer dampers and an exhaust air damper. The Economizer segment shall be an integral part of the unit.
   a. The return air, outside air, and exhaust/relief air dampers shall be sized for 100% of unit airflow.
   b. The return air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max] [25%/75% split].
   c. The outside air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max] [25%/75% split].
   d. The exhaust air outlet shall [be left open, having no damper] [be blanked off, having no damper option] [have standard control damper][have barometric relief damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max(if any)].
   e. Outdoor units shall be provided with a rain-hood and bird screen assembly for protection of the outside and exhaust air dampers from the elements. The outside air hood shall have a [moisture eliminator].

f. A factory installed safety screen shall be provided over all bottom inlet openings, sufficient to hold 300 lb. service person with minimal deflection.

g. [Provide associated return or exhaust fan as scheduled].

K. **Diffuser (DI) segment(s)** shall be supplied as indicated on the drawings. Diffuser segment(s) shall be supplied with a perforated diffuser plate used to distribute high-velocity fan discharge air across the entire tunnel face to assure even distribution of airflow across the entire unit air tunnel. Diffuser segment(s) shall be located immediately downstream of DWDI fans discharging into blow-through coils or filters. Units with fans blowing directly into coils and/or filters shall be unacceptable.

L. **Access (XA) segment** shall be supplied as indicated on the drawings. Access segments shall be of length specified in schedule.

M. **Discharge plenum (DP) segment** shall be supplied as indicated on the drawings [horizontal] or [vertical] application. Discharge plenum segment(s) shall be supplied with factory discharge opening(s) in locations shown on the drawings.

a. Discharge plenum segment shall be supplied with a factory installed safety screen over all air bottom openings.

N. **Filter/Economizer (EF) segment** shall be supplied as indicated on the drawings. Filter/Economizer segment shall accommodate 2" angled filter media and shall control mixing of outside air and return air through the use of modulating economizer dampers and an exhaust air damper. The Economizer segment shall be an integral part of the unit.

a. The return air, outside air, and exhaust/relief air dampers shall be sized for 100% of unit airflow.

b. The return air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced] [25% min/max] [25%/75% split].

c. The outside air inlet shall [be left open, having no damper] [have Airflow Monitoring Station] [be blanked off, having no damper option] [have standard control damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max [25%/75% split].

d. The exhaust air outlet shall [be left open, having no damper] [be blanked off, having no damper option] [have standard control damper] [have barometric relief damper], constructed of [aluminum] [galvanized steel] with parallel [opposed] blades. Damper configuration shall be full faced [25% min/max].

e. Outdoor units shall be provided with a rain-hood and bird screen assembly for protection of the outside and exhaust air dampers from the elements. The outside air hood shall have a moisture eliminator.

f. A factory installed safety screen shall be provided over all bottom inlet openings, sufficient to hold 300 lb. service person with minimal deflection.

g. Provide associated return or exhaust fan as scheduled.

O. **Supply fan (FS) segment** shall be supplied as indicated on the drawings. Supply fan segments shall be equipped with [double width double inlet (DWDI) housed fans] or [single width single inlet (SWSI) plenum fans as scheduled].

a. Supply fan segments shall be equipped with [a single belt-drive fan], or [single, direct-drive fan] as scheduled.

b. Supply fan segment shall include a factory installed safety screen on all air opening.

Return fan (FR) segment(s) shall be supplied as indicated on the drawings. Return fan segments shall be equipped with [double width double inlet (DWDI) housed fans or [single width single inlet (SWSI) plenum fans] as scheduled.

c. Return fan segments shall be equipped with [a single belt-drive fan], or [single direct-drive fan] as scheduled.

d. Return fan segment shall include a factory installed safety screen on all bottom air opening.

P. **Exhaust fan (FE) segment** shall be supplied as indicated on the drawings. Exhaust fan segments shall be equipped with [double width double inlet (DWDI) housed fans].

a. Exhaust fan segments shall be equipped with a single belt-drive fan as scheduled.

b. Exhaust fan segment shall include a factory installed safety screen on all bottom air opening.

c. A factory installed safety screen shall be provided over all bottom inlet openings, sufficient to hold 300 lb. service person with minimal deflection.

Q. Integral Face and Bypass Coil segment shall adhere to the following specifications:

1. Shall be ARI certified

2. Each heating coil to consist of built-in series of finned heating elements and by-passes with interlocked dampers controlled by op-

tional electric damper motor(s) and air stream thermostat.

3. Dampers to be arranged so as to completely enclose and isolate the heating coil passes when no temperature rise is required.
4. Each coil shall be capable of maintaining a constant discharge air temperature regardless of variations in entering air temperatures with full steam pressure or water flow at all times.
5. Proportioning of the air shall be such that the temperature at any point in a plane parallel to the face of the coil three feet downstream from the leaving side will not vary more than ±5°F from the average discharge air stream temperature.
6. Finned heating elements shall be fabricated of seamless 5/8 inch O.D. copper tubes with 0.035 inch wall thickness and rectangular embossed aluminum fins of 0.010 inch thickness.
7. Fins shall not be spaced closer than 12 fins per inch.
8. Each tube shall be individually secured to the supply and return headers by a brazed joint with provision for individual tube expansion and contraction.
9. Headers shall be 3 inch SCH 40 pipe.
10. Volume of air passing through the coil shall not vary more than ±5°F, regardless of the position of the internal dampers.

R. Vertical discharge plenum (VP) segment shall be supplied as indicated on the drawings for vertical airflow application.

S. Indirect Fired Gas Heater

1. Interior and exterior frame structure, and casing, shall be of G-90 galvanized steel. The cabinet construction shall be double-wall G-90 galvanized steel construction, with 18 gauge exterior panels and 20 gauge interior liner panels.
2. Front casing double-wall construction shall be internally insulated comprising three-inch thick, 3PCF density fiberglass insulation, providing R-13 thermal resistance.
3. Double-wall construction shall be internally insulated comprising one-inch thick, 2PCF density fiberglass insulation, providing R-4 thermal resistance.
4. Base Channels shall be of 10 gauge steel 'C' channels, minimum 3" height, spanning width of unit, perpendicular to air flow, secured by weld procedure, forming a rigid structural support base.
5. At heat exchanger, airflow outlet 1" duct flanges, of 18 ga. galvanized formed steel, shall be provided to accommodate connection of heat exchanger module to downstream ductwork, or other system components.
6. The Heat Exchanger shall be a multi-pass design featuring a gasketed flue gas tight positive seal suitable for internally pressurized forced draft natural gas firing.
7. Primary heating surface shall be of fully welded construction type 430 stainless steel comprising cylindrical combustion chamber, and reversing chamber, with 2nd pass 16 gauge type 304, 409 or 430 stainless steel firetubes, secured to reversing chamber and flue gas exit assembly by attachment weld. 4" OD Firetubes shall incorporate 20 gauge type 304 or 430 stainless steel multi-plane turbulators to assure turbulent flue gas flow.
8. Full access to flue gas exit assembly shall be accommodated through cabinet exterior casing access panel at ID Fan mounting flange. Internally, a removable gasketed flue gas tight positive sealed flue gas exit assembly access panel permits direct access to firetubes and turbulators to accommodate Heat Exchanger internal inspection, cleaning and turbulator replacement.
9. A condensate drain connection shall be provided internally within cabinet, from heat exchanger reversing chamber to the flue gas exit assembly and piped externally to same connection of ID Fan housing.
10. Condensate drain piping shall be Schedule 40 type 304 stainless steel pipe and fittings.
11. A factory mounted and wired Induced Draft Fan (ID Fan) shall be of direct drive centrifugal type, self-ventilating motor with ball bearings capable of withstanding Flue Gas Outlet temperatures.
12. The fan shall incorporate a split double-inlet wheel applied such that 80% of the capacity is used for flue gas induction, while 20% draws cooling air over the inboard motor bearing and shaft.
13. An adjustable diaphragm actuated air proving switch shall sense negative pressure at the fan inlet and shall be interlocked with the control circuit.

14. A rectangular to cylindrical 16 gauge type 430 stainless steel flue gas outlet breeching transition fitting to accommodate cylindrical breeching system.
15. The housing of the induced fan shall have a condensate drain connection that shall be pre-piped to main heat exchanger condensate drain piping manifold.
16. The modular duct furnace shall be provided with a NEMA–1 control station which shall accommodate a single point electrical connection, suitable for 460v-3ph-60hz main supply voltage, incorporating a 120v-1ph-60hz step down transformer to further accommodate control circuit and applicable fractional motor horsepower loads.
17. Applicable 3ph line starters, fractional motor and control circuits shall be properly fused.
18. Mounted and pre-wired operating controls including an automatic operating/recycling and manual reset temperature limit, and airflow proving device, shall be provided.
19. The modular duct furnace shall operate automatically at the command of a 'Heat On' signal, provided by BMS. A set of dry contacts shall be provided for 'Heat On' firing sequence verification.

T. ELECTRIC HEAT SEGMENT

Electric heat of capacity, voltage and steps of control specified will be provided as an integral part of the unit. The electric heater and control panel will be a UL recognized electric duct heater.

All electric heater elements will be of 80% nickel and 20% chrome. Coil elements will float freely in ceramic bushings, which are stacked in support brackets, not exceeding 4.5 inches apart. Coils will be machine crimped into stainless steel terminals, which are insulated with high temperature ceramic insulators. Heater casing and support brackets will be of galvanized steel.

All heaters will be supplied with internal wiring of controls, contactors, etc. including 120 volt, 60 hertz control circuit transformer, automatic reset thermal cutout and fuses per NEC and UL (on heaters exceeding 48 amps).

U. IP SEGMENT

Inlet plenum (IP) segment(s) shall be supplied as indicated on the drawings for horizontal airflow application. Inlet plenum segment(s) shall be supplied with factory discharge opening(s) in locations shown on the drawings

2.11 FINISHES

A. Air-handling units shall be painted prior to shipment, as specified.
   a. The exterior of the unit shall be completely cleaned prior to application of finished coats.
   b. A prime coat shall be applied to the unit.
   c. A finish coat of desert sand (or other owner approved color) acrylic polyurethane shall be applied.
   d. The finished unit shall exceed 500-hour salt spray solution (5%) without any sign of red rust when tested in accordance with ASTM B-117.

B. G90 galvanized exceed 250-hr
   a. Shrink-wrap for indoor units.

PART 3: EXECUTION

3.01 INSTALLATION

A. General: Installing contractor shall install air handling unit(s), including components and controls required for operation, in accordance with air handling unit manufacturer's written instructions and recommendations.
   a. Air handling unit(s) shall be stored only in a clean, dry place, protected from weather and construction traffic.
   b. Air handling unit(s) shall be handled such that damage to components, enclosure, and finish is avoided.
   c. Isolate fan segments with flexible duct connections.

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Guide specification to be used as a basis for design when using optional factory- supplied factory package end devices and controls.

   a. Factory mounted end devices will imply a package of devices that would be able to tie into any control manufacturers building automation system & would be mounted and commissioned at the HVAC manufacturer's factory.

B. These specifications should be reviewed to match the specific system control requirements and available control packages.

1.02 GENERAL REQUIREMENTS

A. The controls shall be an integral part of the air handler, with start-up an available option and warranty supported provided by the air handler manufacturer.

B. The air handler shall carry the ETL approval.

C. The factory package control (automatic temperature control) system shall utilize electric/electronic control. Valve and damper actuation shall be electric/electronic control, except where specific devices to be required to be pneumatically actuated.

D. Factory supplied control panel shall include power supplies for main control panel, actuators (including valve actuators) and transducers provided as part of the air handling unit assembly. **(if mount and wire)**

E. The manufacturer and provider of the air handler and controls shall be regularly engaged in the engineering, programming, installation and service of control systems of similar size and complexity. Bids from franchised dealers, wholesalers, contractors, manufacturers representatives, or any firm whose principal business is not manufacturing and installing Building Automation System's shall not be acceptable.

F. The manufacturer and provider of the air handler and controls shall be in compliance with ISO 9001. The intent of this specification requirement is to assure that the products from the provider are delivered through a quality system and framework that will assure consistent quality in products delivered.

1.03 DELIVERY, STORAGE AND HANDLING

A. Please be advised that the following information does not imply that York International is condoning the storage of indoor units outdoors. Nor does the information imply that York International is assuming responsibility for the storage of the units and or the condition of the units during and after the storage period.

B. Helpful Hints for long term storage:

C. Control panels, electronic or pneumatic devices and/or air modulators must be removed and specially enclosed and protected from moisture and humidity with desiccant bags. Replace the desiccants every 30-60 days depending on the Relative humidity during the storage period. RH greater than 60% requires changing bags every 30 days. Electronic equipment cannot be stored in wet or damp areas even though they are sealed and secured.

D. Motors should be protected and inspected in accordance with the manufacturers specific instructions regarding periods of long storage. Periodic rotation of the shaft is required during long storage periods. Provisions should be made to ensure no water is allowed to collect and remain in the motor terminal box or any electrical junction box.

E. Follow responsibilities and guidelines listed on Form 50.20-NM3.

F. Protection of the complete unit for avoidance of general rusting must be handled as best suits the circumstances. Alternatives would be to provide a special paint to meet anticipated climatic conditions during storage and/or building a special frame to shelter the units from environmental conditions (venting the space accordingly).

G. All loose-shipped items need to be packed, protected and secured with the air units. All the above precautions apply to all loose-shipped items.

1.04 WARRANTY

1.04.1 Warranty is limited to manufacturers defect only.

1.04.2 Warranty will be as per the standard airside products warranty. Warranty is not extended to any alteration, modifications or external component attached to "original" equipment "as-built" and shipped from YORK manufacturing facilities. All factory provided controls will carry the "Limited Warranty" as described in FORM 50.05-NM2.

PART 2 PRODUCTS

2.01 SYSTEM CONTROL DEVICES & SPECIFICATIONS

A. The FACTORY MOUNTED END DEVICE option shall provide the capability to perform any of the following functions per the specific devices provided.

2.02 DEVICE SPECIFICATIONS (INCLUDE SECTION AS DEVICE IS SELECTED IN YW)

AIR FLOW MONITORING (25-OAF, 75/100 OAF)

The YORK AMS-60 airflow monitoring station combines the functions of control damper and airflow measurement station in one assembly. Shall be factory installed in Solution air handling units. The AMS-60 shall be tested to AMCA Standard 611-95 and shall bear the AMCA Ratings Seal for Airflow Measurement Performance.

Temperature Sensors (SAT/RAT)

The Temperature Sensor line offers an economical solution for a wide variety of temperature sensing needs. Each sensor provides precision remote temperature sensing for building automation systems.

The duct temperature sensor is designed for direct mounting on sheet metal duct systems. The sensor is point sensitive and comes with 2" & 9" insertion depths.

Sensors are available in the following types:

1k RTD 8" Duct Immersion
1k RTD 3" Duct Immersion
10k Type III thermistor 9" Duct Immersion
10k Type III thermistor 2" Duct Immersion
10k thermistor 9" Duct Immersion
10k thermistor 2" Duct Immersion
100k thermistor 9" Duct Immersion
100k thermistor 2" Duct Immersion
20k thermistor 9" Duct Immersion
20k thermistor 2" Duct Immersion

Averaging Sensor (HCDT, CCDT, MAT)

The duct-averaging sensor is designed for direct mounting to sheet metal for average duct temperature sensing. The sensor is multi-point sensitive through the length of the temperature conductive tubing

Sensors are available in the following types:

1k RTD 17' Averaging Sensor
1k RTD 8' Averaging Sensor
10k Type III thermistor 25' Averaging Sensor
10k Type III thermistor 8' Averaging Sensor
10k thermistor 25' Averaging Sensor
10k thermistor 8' Averaging Sensor
100k thermistor 25' Averaging Sensor
100k thermistor 8' Averaging Sensor
20k thermistor 25' Averaging Sensor
20k thermistor 8' Averaging Sensor

Outside Air Sensor (OAT)

The temperature sensor provides precision remote temperature sensing in multiple applications such as Duct, OSA, and immersion installations for building automation systems.
Sensors are available in the following types:
1k RTD Outside Air Sensor
10k Type III thermistor Outside Air Sensor
10k thermistor Outside Air Sensor
100k thermistor Outside Air Sensor
20k Thermistor Outside Air Sensor

Static Pressure Transducer (SAP, FDP1, 2, 3, REFSP, DXFC, ZP)

The choice of pressure probe, which is designed to pick up static pressure in a duct, plenum, air handler or other HVAC equipment are 100% solid state, micro- machined, glass on silicone ultra stable capacitance sensor.

Sensors are available in the following types:

Static Pressure Transducer
Probe for S.P. Trans. above (Use on high side)
Static Pressure Transducer FlexSys
Probe for S.P. Trans. above (Use on high side)
Building Static Pressure

Damper & Valve Actuator on/off 2-10v

The Electric Spring Return Actuator shall allow direct-mount, spring return line of electric actuators that operates on 24 VAC or VDC power and is available for use with on/off, proportional controllers. These bi-directional actuators shall be factory mounted and sized to operate the devices they are connected to.

Differential Pressure Switch (SFP, FDP1, 2,3, REFP, HAFC)

The differential pressure switch is for use in applications where a proof of airflow is needed for proper system operation. All switches are designed for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls), or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

Duct-mount Humidity/Temperature Sensor (OARH, RARH, SAH)

The sensor combines humidity and temperature sensing in a single surface-mounted unit for use inside economizers. The humidity sensor is capable of measuring humidity over the range of 0 to 100% RH, and its construction increases resistance to corrosion in HVAC environments. The sensor (a thin-film nickel sensor) can be powered with 14 to 30 VDC or 20 to 30 VAC and features a user-selectable output of 0 to 5 VDC.

Freeze stat/Low Limit Temperature Cutout Control (FS)

Low temperature cutout controls shall have DPST contact action or be supplied with a powered relay that has DPDT contacts.

The low temperature cut out shall be factory installed so that the top and bottom 1 ½" is protected and the remaining sensing element is spaced evenly across the face of the coil. The controls shall have an adjustable temperature set point range with a fixed differential. The range adjustment screw is accessible at the bottom of the control, and at the top of the control when the cover is removed. The setting shall be set at the factory for 35° F.

High Temperature Manual Reset Control (HTC)

The single-pole control is supplied in a wide selection of ranges to meet most application needs. Models may be supplied to open a circuit on temperature increase. A single-pole control may optionally include a separate reverse-acting auxiliary contact.

Static Pressure Limit Manual Reset (SPC, RELPC)

The sensing switch is designed to sense static pressure or differential pressure and break an electrical circuit when the set point is exceeded. The electrical circuit will remain open until the reset button on the switch is pressed.

IAQ Sensor (ZIAQ, IAQ, OAQ)

The sensor to be used for demand control ventilation – specifically for CO2 sensing. Controls the ventilation system to ensure the right amount of fresh air when and where you need it. Applications extend to control ventilation in a building where occupancy varies frequently; control ventilation to ensure excess outside air is not causing energy waste; ensure good air distribution throughout zones.

Duct Humidity Limit (Auto Reset) (HHLR-6, HHLR-3)

The control will limit duct humidity by comparing a controller's request for humidification with the humidity present in a duct. It will proportionately reduce its output signal to the humidification equipment as duct RH% approaches a user-defined, high-limit set point.

Current Operated Switch for fan status (SFP, REFP)

The control will provide an On/Off status for direct drive fans, pumps and motors. 100% solid state, no moving parts to fail. (Not intended to detect belts breaking)

Zone Temperature & Zone Humidity Sensor

The zone space temperature sensor allows separate heating and cooling settings. Single or dual set point adjustment with choice of warmer or cooler graduation scales in C° or F° .

The humidity sensor shall be capable of measuring humidity over the range of 0 to 100% RH, and it shall be of a construction which is resistant to corrosion in harsh environments. (Optional: shall also include an additional thin-film nickel, thin-film platinum or thermistor temperature sensor for use in enthalpy control and other strategies requiring both humidity and temperature information.)

VoluProbe Air Flow Monitoring

The control is an airflow measuring element assembly specifically designed for installation in the inlet cone of centrifugal fans or inlet bell of vane axial fans. Each assembly is complete with two (2) airflow-measuring elements, pivot mounting hardware and signal connection fittings.

2.03 SYSTEM CONTROL OPERATION CAPABILITIES:

- Control of the chilled water valve to maintain supply-air temperature (SAT)
- Control of stages of direct expansion cooling to maintain SAT
- Control of the hot water valve to maintain return-air temperature to an occupied or un-occupied set point.
- Control of stages of electric heat to maintain return-air temperature or room temperature to an occupied or unoccupied low set point. Fail-safe control mode shall be provided to turn the stages off should the PSIO fail.
- Control fan inlet guide vanes (or field-supplied and installed variable-frequency drive) to maintain static pressure set point (VAV units only).
- Control of mixed-air dampers to provide a constant outside airflow (cfm) during VAV operation.
- Indoor air quality control during occupied times using a single gas, single gas with indoor/outdoor differential control, or using two gases. When a single sensor reaches the field-adjustable setting, it shall modulate outside air control of dampers to reduce sensor (CO2 or volatile organic compound [VOC]) levels. When 2 sensors are used for differential monitoring, they shall accomplish a comparative analyses of VOC gas levels and modulate supply, mixed, or return dampers to provide the best air to the space.
- Nightly purge of stagnant indoor air for a configured duration prior to occupancy.
- Control of mixed-air damper (economizer) to provide integrated use of out-side air to provide free

cooling when controlling supply air, room temperature, or minimum outdoor air.

- Control of two-position dampers to meet minimum outdoor air requirements during occupied periods.
- Control of the supply fan based on the occupancy schedule.
- Control of supply fan to cause adaptable start/morning warm-up of the system.
- Control of the mixed-air damper to maintain a minimum position when the enthalpy switch or differential enthalpy calculation indicates the outside air is un-suitable for cooling.
- Provide alarms based on freeze stat, duct high humidity, pressurization, and evacuation, smoke purge, and fire shutdown input states being true.
- Allow manual and system override of selected output channels and internal values.
- Return fan capacity control.
- Filter maintenance option.
- Smoke evacuation.
- Smoke purge.
- Building pressurization.
- Fire shutdown.
- Humidifier control; proportional analog or two-stage discrete.

PART 3 EXECUTION

3.01 SCOPE OF WORK

1. Factory mounted end devices, less controller, will imply a package of devices that would be able to tie into any control manufacturers building automation system.
   a. It shall be the responsibility of the factory mounted end device provider to properly locate and install the control panels, sensors and all control devices required to implement a fully wired system.
   b. All factory control wiring shall be internal to the unit. Internal wiring shall consist of plenum-rated wire ETL approved. The electrical components shall be listed under UL. The unit shall be in compliance with the NFPA 90A standard and ETL approved.
   c. The mounted and wired end device option shall furnish and install all control and interlock wiring between motor control method and control devices such as start-stop switches, pilot lights, electric relays, low limit thermostats, high limit thermostats, smoke detectors, differential pressure switches, DDC devices and sensors, and associated safety and limit devices.
   d. It shall be the responsibility of the end device provider to properly locate and install the control panels, sensors and all control devices required to implement a fully functional system.

3.02 WIRING WORK

a. The wiring definition within this section applies to either of the optional factory- supplied controls:
b. Factory mounted end devices will imply a package of devices that would be able to tie into any control manufacturers building automation system
c. Electric control wiring shall be in accordance NEC codes & ETL requirements. Specific state and local codes should be referenced to ensure compliance.
d. All factory control wiring shall be internal to the unit. Internal wiring shall consist of plenum-rated wire ETL approved. The electrical components shall be listed under UL. The unit shall be in compliance with the NFPA 90A standard and ETL approved.
e. All plenum rated wiring shall be installed in a neat and workmanlike manner.
f. Line voltage and sensor wire shall not be installed in same wiring harness.
g. Low voltage and communication wiring (less than 30 volts) may be installed in the same harness.
h. The provider shall issue a schematic drawing of the entire control system for the air handler.

3.03 FINAL TESTING PROCEDURE

a. This procedure defining the requirements of material to be furnished and performed is not subject to interpretation.
b. After final assembly of each device, the device shall be tested per the manufacturers standard.
c. The manufacturer final test procedure will assure that the products from the provider are delivered through a quality system and framework that will assure consistent quality in products delivered.
d. Necessary deviations must be approved, in writing, for each case and be applicable only to specific production sales order number.
e. After successful testing, inspector shall apply the marking “TESTED” and date of test (or a serial number

providing the manufacture, the lot and date information).